PATENT SPECIFICATION (11) 1 588 380

1 588 380

(21) Application No. 21655/78 (22) Filed 23 May 1978

(44) Complete Specification Published 23 Apr. 1981

(51) INT. CL.[3] A63B 39/06

(52) Index at Acceptance
A6D 2A

(72) Inventor:- MICHAEL ADRIAN WINSON

(19)

(54) TENNIS BALLS

(71) We, WEBRON PRODUCTS LIMITED, a British Company of Bacup Road, Rawtenstall, Rossendale, Lancashire, BB4 7JL, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention is concerned with tennis balls.

The traditional material used for the manufacture of tennis balls is a woven Melton cloth of a 2/2 twill construction comprising a spun cotton warp and a spun wool or wool/nylon weft. The weft yarns of much coarser count are raised to form a nap and the cloth is then felted back and fulled to produce a cloth of felt like appearance.

The process of manufacturing Melton cloth is expensive because it involves the spinning of yarns, weaving and wet milling of the cloth. Needlefelts offer a cheaper and shorter manufacturing route because of quicker process times, wet milling and finishing are eliminated and a high proportion of wool of milling purposes is unnecessary. Previous needlefelt materials employed for tennis balls have often been based on the fibres of the Melton cloth and as well as being expensive they have not possessed the ideal wearing and aerodynamic properties due to either the fibre type, fibre staple length, fibre denier or support scrim or all four parameters not being an ideal choice or combination. Their failure has been due either to the cloth wearing smooth which allows the ball to travel through the air at too great a speed or to pilling and rat-tailing of the surface fibres. British Patents No.1229781 and No.1074779 both describe the manufacture of such needlefelts.

Nevertheless the use of needlefelt materials for tennis ball covers has the advantage that the surface fibres, which determine the dynamic properties of the ball, can be of much greater depth and area weight than woven cloth. The relatively thin layer of felted fibres on the woven cloth soon wear off and expose the base fabric, making the ball unsuitable for match play. Yet another advantage of needlefelts is that they can be quickly and easily modified either by the inclusion of other fibres into the carded web or by the addition of a further fibrous layer on either the surface or base to change the wear or other properties of the tennis ball. This opportunity to produce quickly short lengths of needlefelt suitable for certain types of tennis ball will be further explained later in the specification.

According to the present invention there is provided tennis ball including an outer cover formed from a scrim having a fibrous needled web bonded thereto.

The cover material used in the invention possesses the ability to conform to a spherical core when cut in the traditional "dumbell" shape thus eliminating wide and variable seam lines. It also imparts the ideal wearing and aerodynamic properties to the tennis ball, i.e. its flight characteristics remain the same throughout its useful life.

Traditionally dumbells are cut out from the cloth in a diagonal configuration to allow the dumbell to be extended both along and across its long axis to aid conformation of the cloth to the sphere. Each cross over point of warp and weft yarns in the Melton cloth is a hinge point which allows the material to extend and contract. The ability to extend in the diagonal direction and to conform to a sphere is provided by the cloth of the invention but the scrim is much lighter, in the order of 2 oz/sq yd, than the Melton cloth.

Scrim having a twill weave has been found ideal for the purposes of this invention although a plain weave is also satisfactory. A twill weave is not as inflexible in the plane of the fabric as a plain weave scrim because at the points where two or more warp yarns cross over weft yarns and vice-versa there is more freedom of movement of the yarns and

consequently more flexibility and conformability. The plain or twill weave scrim can be constructed from spun yarns, monofilament or multifilament yarn or combinations of both and yarns can consist of any of the fibres referred to as textile fibres, e.g. polyamide cotton, wool, polyester, or acrylic. The term scrim as used herein is intended to include spunbonded scrim.

The preferred construction of the neededweb is an all cross-laid fibre construction, by which we mean the fibre direction in relation to the direction of fabric manufacture. The cross-laid fibre construction was found to give more desirable results on test than a straight and cross lay construction or an all straight-lay fibre construction.

A comparison of properties using different scrims and a nylon/wool fibre blend with that of Melton cloth, which also consists of a nylon/wool surface fibre blend, is set out in Table I. The area weights and thicknesses of the materials listed in Table I are identical for the purposes of this comparison.

TABLE I

Property		Melton	Twill Scrim (cotton)	Plain Scrim (nylon)	Spunbonded scrim (nylon)
Bending Length mms		88	100	104	106
% Extension on the bias (@ 1kg/cm load)		22.5%	18.0%	13.0%	12.0%
Extension Recovery (10% stretch)	Bias	9.5%	8.0%	7.3%	5.1%
	Warp	10.0%	7.0%	6.0%	4.0%
	Weft	9.5%	8.0%	7.4%	4.7%

The bending length is a measure of the stiffness and pliability of the material and represents the minimum length required to project over a set edge to the point where that material forms an angle of 45° with the horizontal. The lower the bending length, the more pliable or less stiff the material. The extension on the bias is a measure of the ease by which the material can be stretched along and across the axis of the dumbell and a higher extension will allow the material to be moulded to the ball core easier than a material with a lower extension. Coupled with this property however is a measure of the extension recovery; a material that does not recover will easily be pulled permanently out of shape. As well as a high extensibility, the material must possess the ability to recover more than 75% of the stretch applied to the material.

The fibrous web is preferably composed of up to 50% wool blended with either acrylic fibres, viscose rayon fibres or acrylic fibres with a proportion of nylon or viscose fibres depending on the type of tennis court playing surface. By acrylic fibres we include fibres known as modacrylics, acrylics and polyacrylonitriles. These fibrous blends possess resilience and abrasion properties which allows the felt to wear "hairy", i.e. it retains the aerodynamic properties by not wearing smooth, does not produce pills as do most synthetic blends and does not form rat-tails in damp playing conditions. By rat-tails we mean an accumulation of several fibres wrapped around and intertwined which forms the appearance of a rat's tail.

A further advantage of these blends is that a low temporary thickness can be achieved by decatizing and damp calendering. A low temporary thickness allows balls to be made up which will fit into the moulds and not give rise to mould seam lines around the ball. Both viscose rayon and acrylic fibres lose their resilience under damp heat and pressure. The required nominal thickness of the cover material is recovered later in the tennis ball manufacturing process. In particular it has been found preferable although not always necessary to use fibre deniers between 6 dtex and 13 dtex, and fibre staple lengths of between 55 and 80 mm for the man made or synthetic fibres in the blend. With fibres of the aforementioned blends, deniers below 6 dtex tend to wear smooth and produce pills, and deniers above 13 dtex produce too coarse a handle and rat-tails in damp conditions. Staple lengths below 55 mm were found to give insufficient fibre anchorage and although the aerodynamic properties of the ball are not affected initially, the playable life of the ball is reduced because of the poor wear properties. Staple length above 80 mms gave an increased incidence of rat-tailing in both dry and wet conditions of play.

By way of example a for use in the invention was constructed from a plain cotton scrim, a fibre blend of 40% wool (nominally 35 microns) 60% acrylic fibre (9 den. 63 mm Courtelle)

at an area weight of 18 oz/sq yd finished in the usual manner and compared with an equivalent weight Melton cloth constucted of cotton warp yarns and wool/nylon pile weft yarns. Table II lists the comparison of properties relating to the manufacture of the tennis balls and the material conformability. The felt was then made up into tennis balls and tested in a tennis court simulator to determine its aerodynamic and abrasion properties. The tennis balls manufactured from this blend remained "hairy" throughout the simulator test, retaining their aerodynamic properties and retaining sufficient surface fibre to meet the playing life requirements of tennis balls and maintaining the rebound properties specified by the Lawn Tennis Association.

TABLE II

Property		Melton	Needlefelt (Wool/acrylic)
Bending Length mms		88	98
% extension on the bias (@ 1 kg/cm load)		22.5%	20.0%
Extension Recovery			
(10% stretch)	Bias	9.5%	13.0%
	Warp	10.0%	7.5%
	Weft	9.5%	8.5%

Other fibrous layers may be added either on the surface or base of the needlefelt used in the invention. The addition of fibrous layers, especially of different bulk densities can affect, sometimes adversely, the aerodynamic characteristics of the tennis ball and the fibre blends specified in this invention nullify these adverse effects. By way of example the addition or inclusion of at least one layer of electrically conductive fibres (e.g. stainless steel fibres) wherein the felt is needled so that said fibres are caused to extend to or are adjacent to the surface of the felt, benefit from this invention. A method of producing electrically conductive fabric is described in our co-pending patent application No. 41377/77 (Serial No.). If an electrically conductive tennis ball is produced from felt with a primary fibre blend of wool and nylon, the surface cover wears smooth and the denser layer of electrically conductive fibre affects the flight properties of the ball. By using a felt having a primary fibre blend as specified in this invention, the surface cover does not wear smooth and the tennis ball retains its aerodynamic properties throughout its useful life as a conductive ball.

WHAT WE CLAIM IS:-

1. A tennis ball including an outer cover formed from a scrim having fibrous needled web bonded thereto.
2. A tennis ball as claimed in Claim 1, wherein the scrim is a twill.
3. A tennis ball as claimed in Claim 1, wherein the scrim is a plain weave.
4. A tennis ball as claimed in Claim 1, wherein the scrim is spunbonded.
5. A tennis ball as claimed in any preceding claim, wherein the needled web is of all cross-laid fibre construction.
6. A tennis ball as claimed in any preceding claim, wherein the web contains up to 50% wool fibres blended with synthetic fibres.
7. A tennis ball as claimed in Claim 1 substantially as described herein.

Agents for the Applicants.
WILSON, GUNN & ELLIS.
Chartered Patent Agents.
41 Royal Exchange.
Manchester.
M2 7DB.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1981.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.